United States Patent [19]

Mitter

[11] **4,173,928**

[45] **Nov. 13, 1979**

[54] **SCREEN PRINTING MACHINE**

[76] Inventor: **Mathias Mitter,** Falkenstrasse 57, 4815 Schloss Holte, Fed. Rep. of Germany

[21] Appl. No.: **835,793**

[22] Filed: **Sep. 22, 1977**

[30] **Foreign Application Priority Data**

Sep. 25, 1976 [DE] Fed. Rep. of Germany 2643226

[51] **Int. Cl.**[2] **B05C 17/06**

[52] **U.S. Cl.** **101/126;** 68/200

[58] **Field of Search** 101/120, 122, 123, 124, 101/126, 118; 198/689; 118/848, 50; 8/149.1; 68/200

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,137,230	6/1964	Ichinose	101/123 X
3,313,232	4/1967	van der Winder	101/118
3,618,838	11/1971	Schieren	198/689 X
3,628,654	12/1971	Haracz	198/689
3,715,027	2/1973	Fujimoto	101/122 X
3,818,391	6/1974	Jordon et al.	101/122 X
3,902,414	9/1975	Zimmer et al.	101/126 X
3,941,053	3/1976	Black et al.	101/124
3,949,864	4/1976	Montsant	101/126 X
3,969,999	7/1976	Zimmer	101/123 X

FOREIGN PATENT DOCUMENTS

1252167	10/1967	Fed. Rep. of Germany	101/126
2544808	4/1976	Fed. Rep. of Germany	101/123
451548	9/1949	Italy	101/126
878094	9/1961	United Kingdom	101/123

Primary Examiner—E. H. Eickholt

Attorney, Agent, or Firm—Michael J. Striker

[57] **ABSTRACT**

A printing station includes a printing screen and an endless gas-permeable carrier band of screen material is provided which has a workpiece supporting run extending beneath the printing screen and on which a sheet-material workpiece to be printed is transported. A suction device is arranged below the supporting run for drawing printing ink into the workpiece on the same.

16 Claims, 8 Drawing Figures

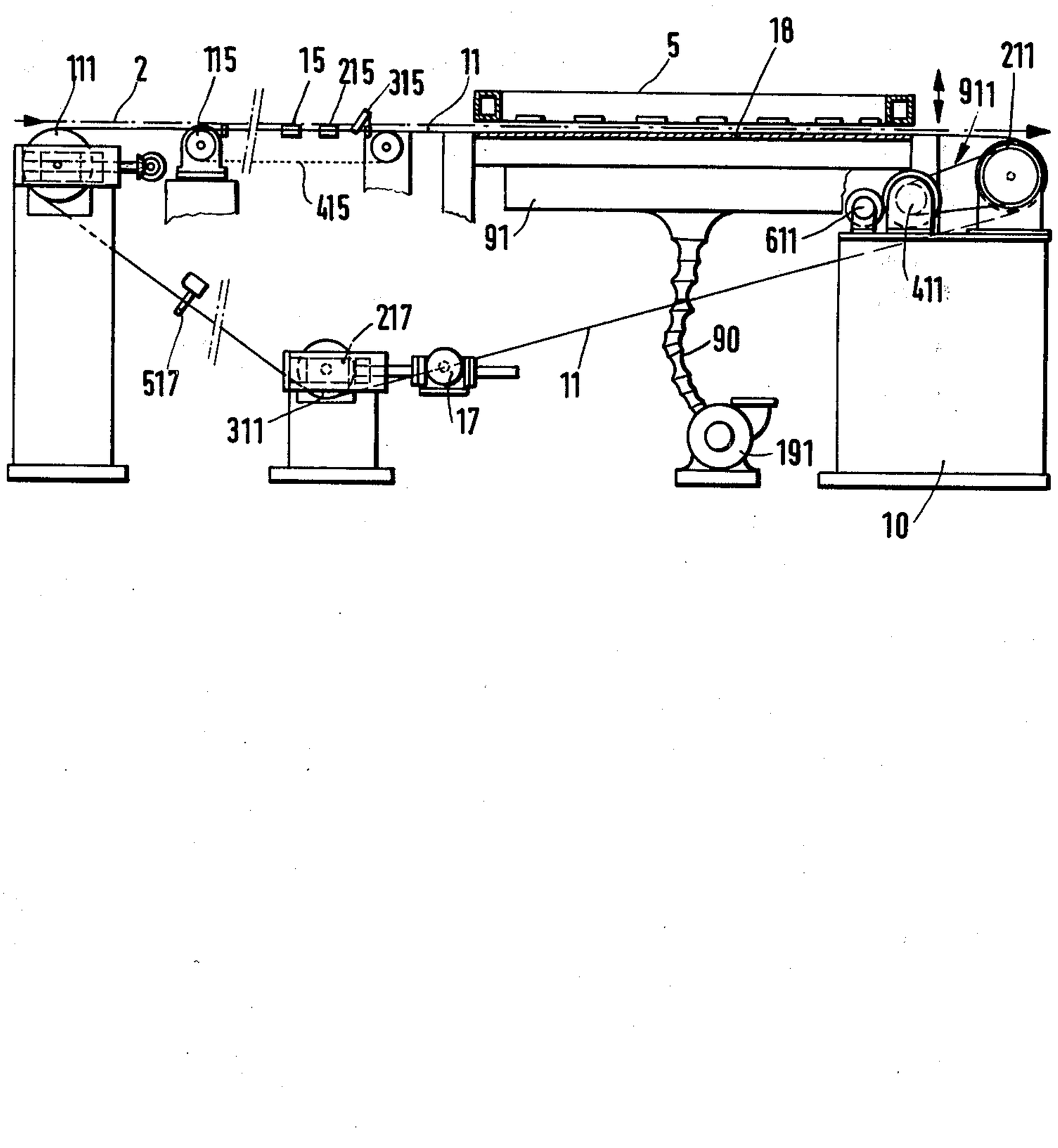

Fig.1

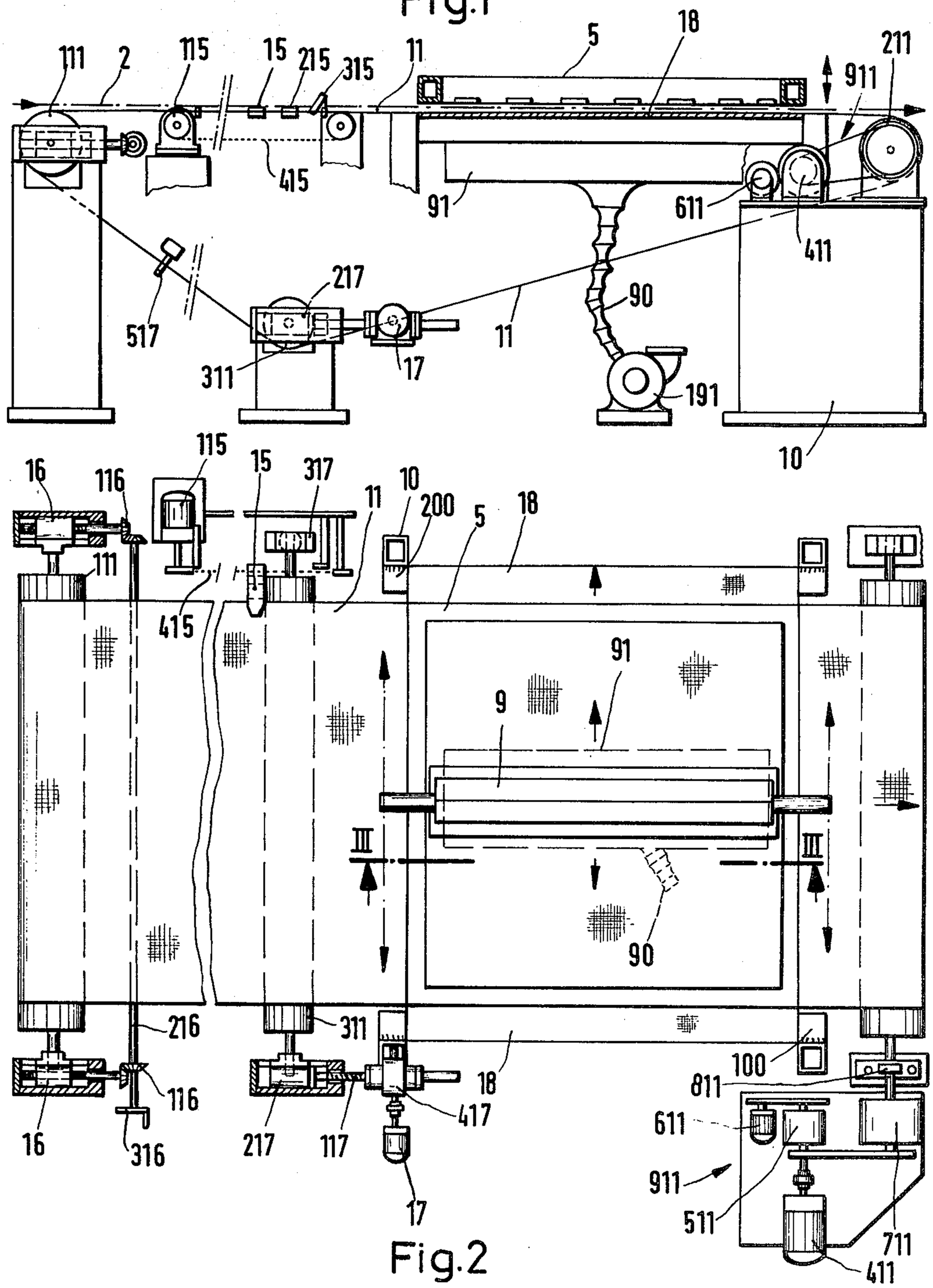
111
2
115
15
215
315
11
5
18
211
911
415
91
611
411
217
517
90
311
17
11
191
10
16
116
115
15
317
10
200
5
18
111
415
91
9
III
III
90
216
311
18
100
811
116
417
611
16
316
217
117
911
17
511
711
411

Fig.2

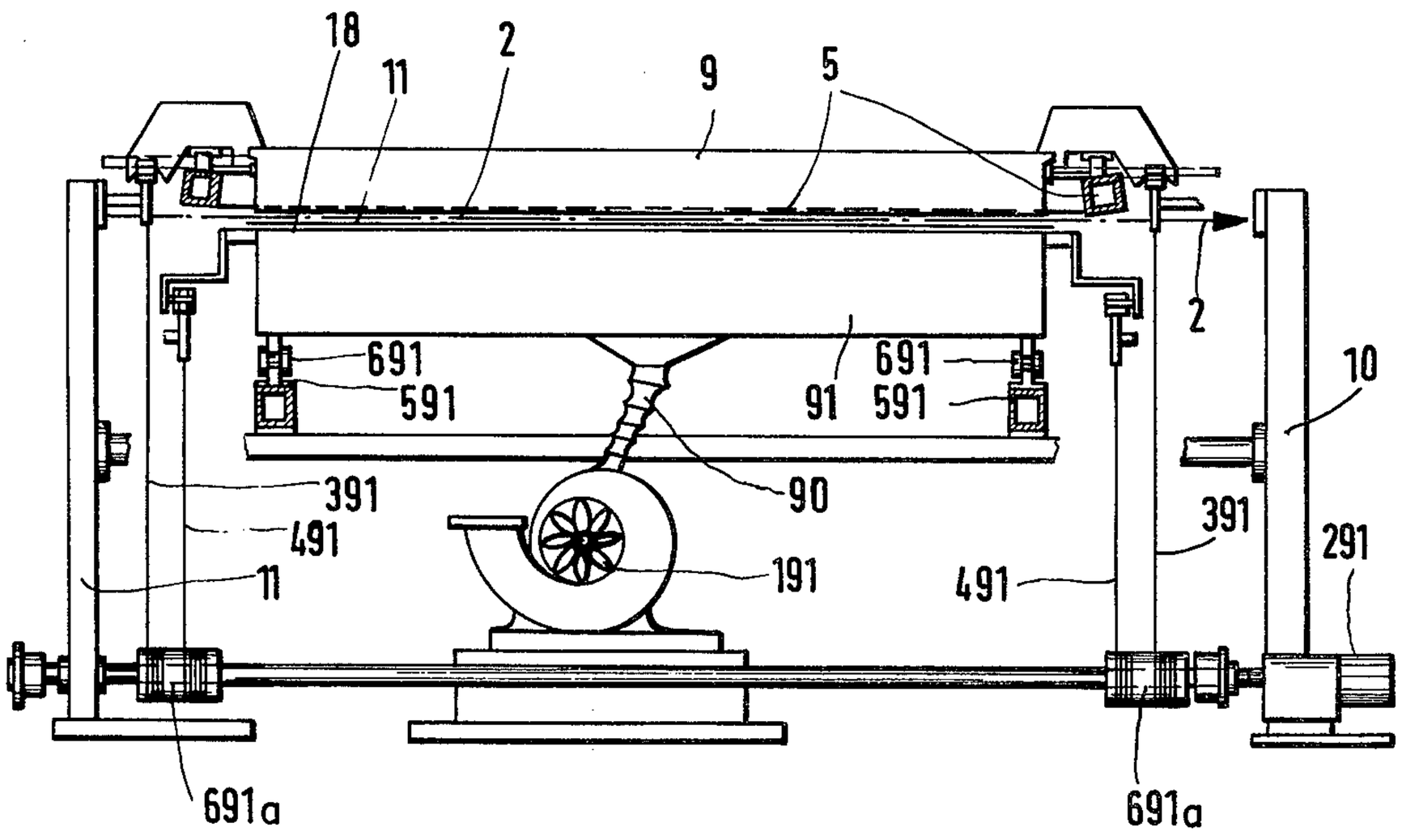
18
11
2
9
5
2
691
591
691
591
91
10
90
391
491
391
191
11
491
291
691a
691a

Fig. 3

Fig.4

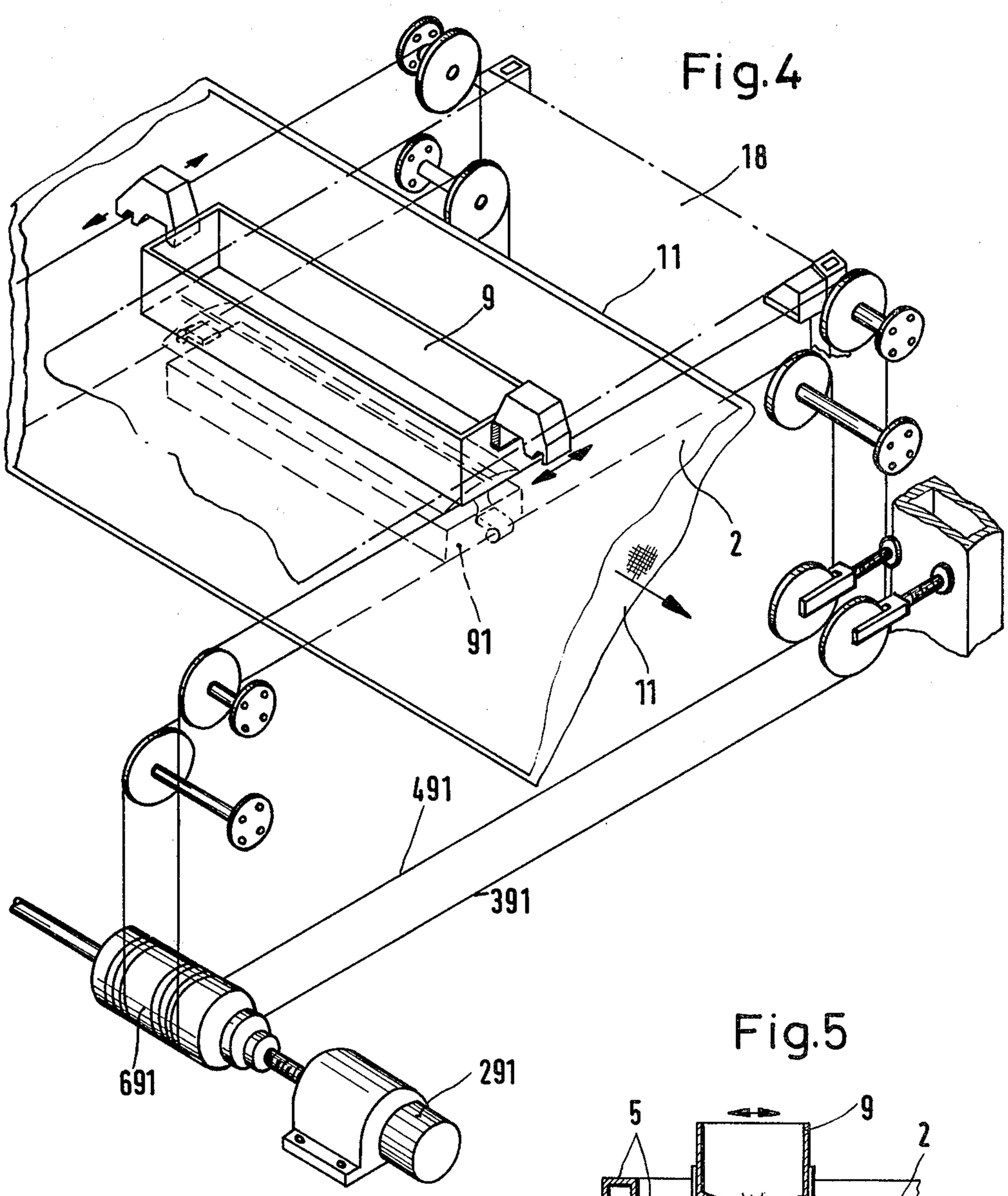

Fig.5

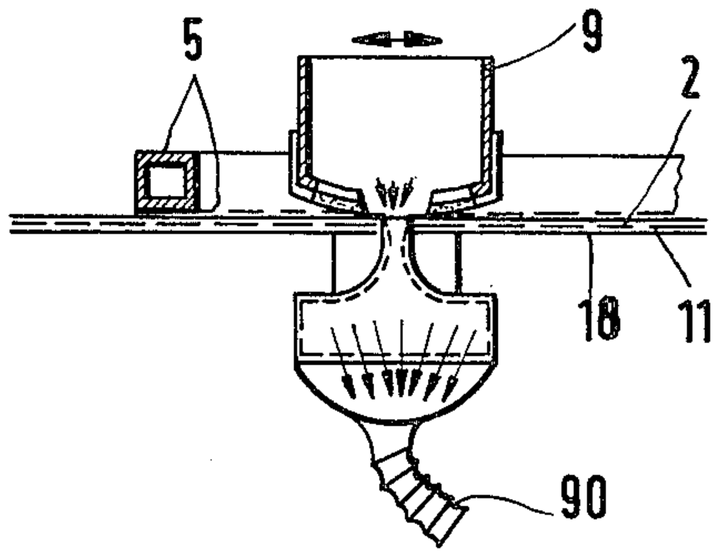

Fig.6

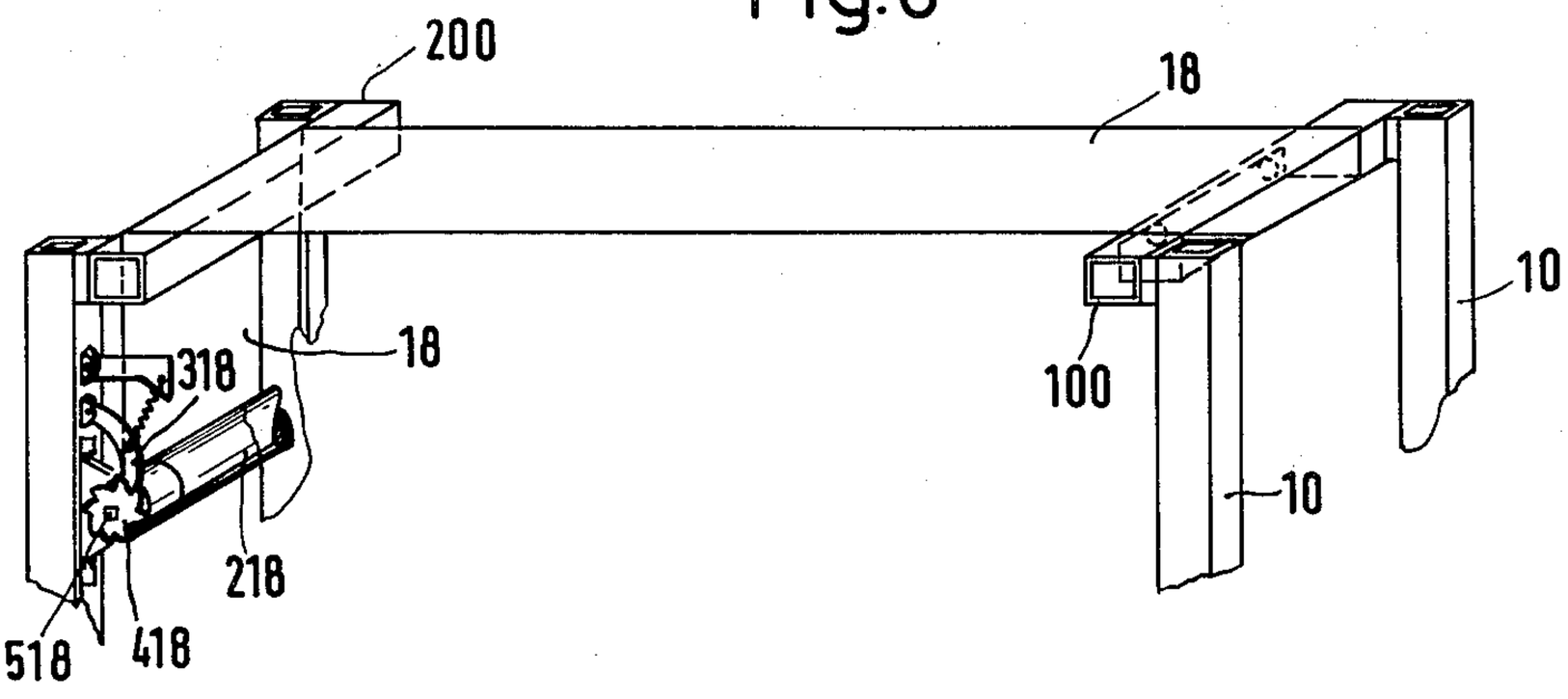

Fig.7

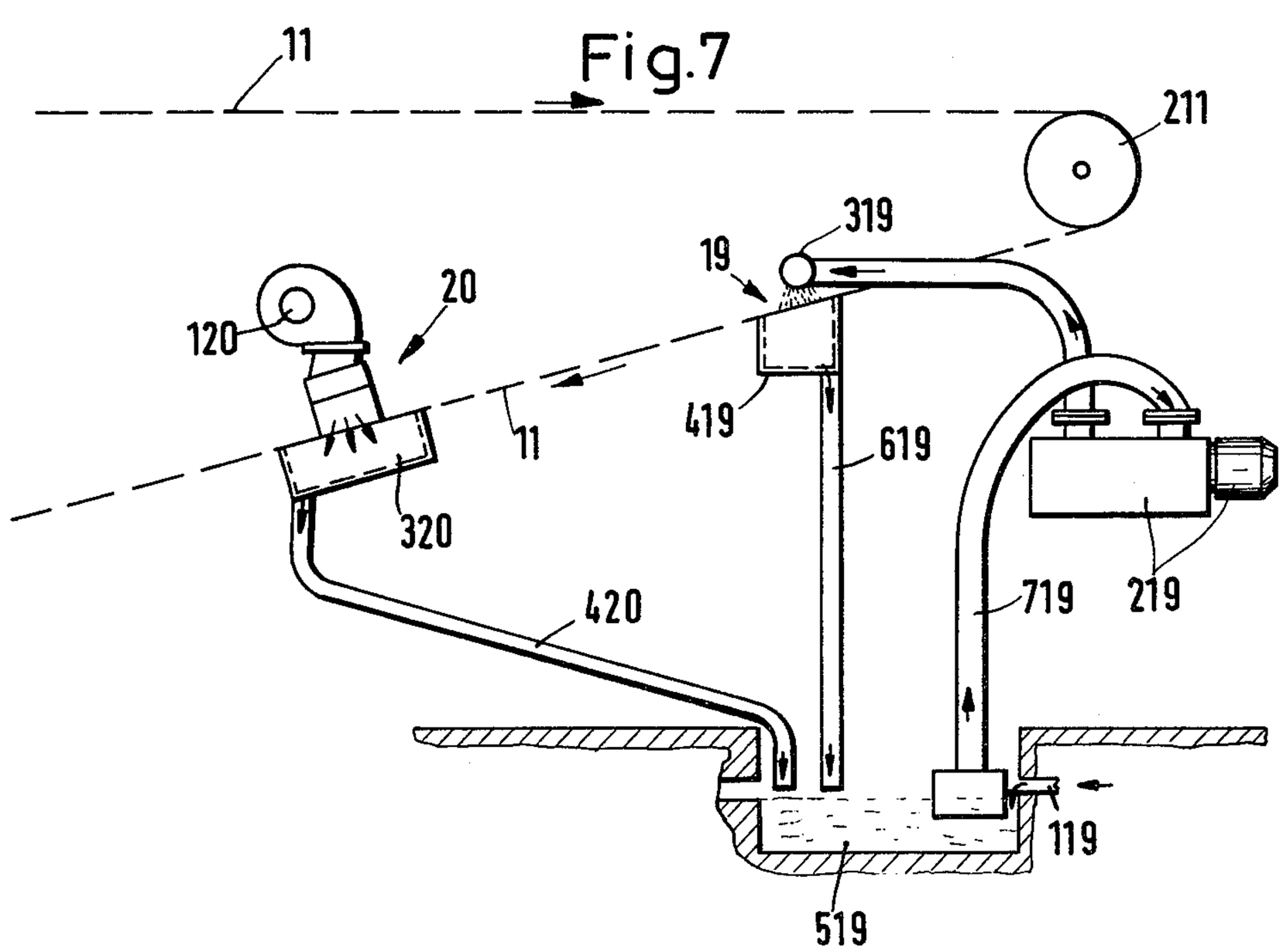

Fig.8

SCREEN PRINTING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a screen printing machine.

More particularly, the invention relates to a screen printing machine for printing on sheet-material workpieces which are supported on a carrier that advances in an endless path.

2. The Prior Art

Screen printing machines of the type here in question are already known. They may utilize an annular printing screen, i.e. a printing screen which itself is endless, or they may even use a different kind of printing screen, for example a stencil-type screen. The sheet material workpiece to be printed, which may be in form of endless or near-endless webs or in form of individual sheets, is usually supported on a printing blanket of rubber or an analogous material. These printing blankets are endless and are guided around reversing rollers located at the front end and at the rear or outlet end of the machine. During its travel in the return run, i.e. as the printing blanket returns from the rear end to the front end of the machine, it must be cleaned so as to remove from it any contaminants, e.g. printing medium or the like which might adhere to the printing blanket so that when it reaches the workpiece supporting run again it is clean and ready to receive the workpiece.

The problem is that these known printing blankets are not gas permeable but that there are many applications in which it is desired to apply suction in order to draw printing medium—e.g. printing ink or printing paste, adhesive, a textile treating material or any other material that can be printed with a screen printing machine onto the workpiece—into the workpiece structure. When this type of operation is required it is therefore the practice in the industry to work without a printing blanket, as is for example disclosed in German allowed application DT-AS No. 1,252,167. In this prior-art machine the workpiece to be printed is engaged at lateral sides of the machine by chains which pull it through the machine over air-permeable plates located at the printing station or stations. This has the advantage that any air-permeable workpiece can be printed according to the suction principle, i.e. suction is applied through the workpiece to draw printing medium into the same. However, there are certain circumstances in which this approach is not satisfactory, for example if the workpieces are heavy ones (e.g. carpets, rugs or the like) which tend to pull out of shape due to their own weight so that, espcially when a pattern is to be printed on the workpiece at successive stations with each pattern to be printed in registry with the preceding pattern, difficulties may occur with respect to obtaining the desired registry. The attempts which have been made in the prior art to avoid this are not always satisfactory, particularly if a high-quality print result is to be obtained.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to avoid the prior-art disadvantages.

More particularly, it is an object of the present invention to provide an improved screen printing machine which can operate according to the suction principle but is provided with a carrier band on which the workpiece to be printed is supported during its entire travel through the machine.

Another object of the invention is to provide such a screen printing machine wherein pattern registry is reliably assured.

Still a further object of the invention is to provide such a screen printing machine in which pulling out-of-shape of the workpiece is precluded.

In keeping with these objects, and with others which will become apparent hereafter, one feature of the invention resides in a screen printing machine which, briefly stated, may comprise a printing station including a printing screen, means for supporting and transporting a sheet-material workpiece to be printed, including an endless gas-permeable carrier band having a workpiece supporting run extending beneath said printing screen, and suction means below the supporting run for drawing printing ink into the workpiece on the supporting run.

The carrier band may be advanced either continuously or intermittently (stepwise) and of course more than one printing station may be provided. If more than one printing station is provided, then the printing stations will be arranged in sequence, one behind the other, and the carrier band will sequentially transport the workpiece to all of them. Since the workpiece is supported on the supporting run of the carrier band it cannot become pulled out of shape, e.g. stretched or the like, so that the registry of successive prints is greatly increased and thus the equality of the final printed product significantly enhanced.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a somewhat diagrammatic side view illustrating a screen printing machine according to the invention;

FIG. **2** is a top-plan view of FIG. **1**;

FIG. **3** is an embodiment analogous to although slightly different from the one in FIG. **2**, in a section corresponding to the section indicated by line III—III of FIG. **2**;

FIG. **4** is a perspective view, partly section, of the embodiment in FIG. **3**;

FIG. **5** is a diagrammatic sectioned view, illustrating the operation of the suction applying device disclosed herein;

FIG. **6** is a partly sectioned fragmentary perspective view, showing a protective belt which can be used in conjunction with the carrier band in the embodiments of the invention disclosed herein;

FIG. **7** is a diagrammatic simplified, partly sectioned view illustrating a washing arrangement for washing the carrier band; and

FIG. **8** is a fragmentary section through the carrier band itself.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Referring now to the drawing, and firstly to FIG. **1**, it will be seen that the screen printing machine accord-

ing to the present invention has a machine frame **10** with which there are associated one or more printing stations each having a printing screen, here illustrated in form of a flat-screen stencil **5**. The purpose of the machine is to print on sheet material of any type, such as continuous webs or individual sheets which, if they are to be used in conjunction with the suction device to be discussed subsequently, must of course be permeable to gas. The workpieces of sheet material are identified with reference numeral **2** in all Figures.

These workpieces are supported and conveyed through the machine on an endless gas-permeable carrier band **11** which is configurated as a screen band, as most clearly shown in FIG. **8**. Of course, other embodiments than the one illustrated in FIG. **8** are possible, for example a flexible belt with a large number of perforations per unit surface area could be employed instead. In any case, the carrier band **11** is trained about reversing rollers **111** and **211** as shown in FIG. **1**, located at the inlet end and at the outlet end of the machine, respectively. Also provided is a band adjusting roller **311** which engages the band in the return run of the same. Reference numeral **911** identifies a drive for the screen band **11** to advance the same in an endless path in clockwise direction; this drive may serve to either advance the band **11** continuously or discontinuously (stepwise). This may depend upon the type of printing screen, i.e. the drive would normally operate stepwise if a flat-screen stencil **5** is used but could operate continuously if a tubular printing screen or a generally annular printing screen were employed which are known from the art.

Particularly if a plurality of printing stations is provided each using a flat-screen stencil **5**, then it is necessary to assure an exact registry of the print at each station with the print produced by the preceding station or stations, and to control the discontinuously operating drive **11** for this purpose. This is effected according to the present invention by measuring means including a measuring device (tongs) which can open and close electrically and straddles one edge portion of the carrier band **11**. A separate motor **115** and chain **415** are provided for the device **15** to advance the same. Arranged in the path of movement of the device **15** are switches **215** and **315**, and the path of movement of the device **15** is advantageously (but not necessarily) arranged ahead of the printing stations as considered in the direction of movement of the carrier band **11**. In the embodiment shown in FIG. **1** the device **15** is electrically connected with the drive **911** for the band **11**, via the switches **215** and **315**. In this embodiment the drive **911** has a main motor **411**, a creep-drive motor **611** and a compensating transmission **511**. There is also provided a transmission **711** and a coupling **811**. It should be noted here that the structural details of the device **15** are known per se in other arts, although not in this particular art.

In operation the device **15** closes about an edge portion of the carrier band **11** before the same is advanced (this refers to intermittent advancement) so that the device **15** is taken along as the band **11** advances and thus measures exactly the distance through which the band **11** advances. When the device **15** passes the switch **215** which is preset for a specific length of carrier band advancement, it trips the switch **215** which shuts off the motor **411** so that only the motor **611** and the compensating transmission **511** continue to operate, thus slowing down the further advancement of the carrier band **11** to a creeping speed. At this slow speed the carrier band **11** continues to advance until the device **15** reaches the second switch **315** which is located downstream of the switch **215** and trips it. The switch **315**, when tripped, shuts off the motor **611** or else it disengages the coupling **811**, so that the carrier band **11** now stops. The motor **115** then operates and returns the device **15** via the chain **415** to its starting position as shown in FIG. **1**.

The reversing roller **111** for the carrier band **11** may be constructed as a tensioning roller as indicated in FIG. **1**, being provided for this purpose with a tensioning device **16**. For example it may be journalled at both axial ends in bearings which are movable lengthwise of the direction of advancement of the carrier band **11**, and bevel gear drives **116** connected by a common shaft **216** and adjustable by a handwheel **316** (FIG. **2**) may be provided to advance the journals and thereby the roller **111** towards the left or the right (in FIGS. **1** or **2**) so as to tension the carrier band **11** to the requisite extent.

The roller **311** is provided at one axial end with a pivot bearing **317** which is pivotable about an upright pivot axis, i.e. a pivot axis which extends normal to the direction of advancement of the supporting run of the carrier band **11**. At the other axial end the roller **311** is connected with a control motor **17** which acts upon a drive **417** having a screw spindle **117**. The screw spindle **117** in turn acts upon a journal **217** for the roller **311**, which journal is movable lengthwise of the direction of advancement of the upper run of the carrier band **11** so that the roller **311** can be pivoted about the pivot axis of the pivot bearing **317**. This is done in order to assure that the carrier band **11** moves in a straight line over the rollers **111**, **211**, i.e. that it does not shift axially on these rollers or, if it does shift, to restore it to its original position. A feeler **517** is shown in FIG. **1** and is electrically connected with the control motor **17** to sense the position of one edge of the carrier band **11** and to control the movement of the journal **217** so as to restore the carrier band **11** to its predetermined axial position on the rollers **111**, **211** whenever a deviation from this position occurs.

Also shown in FIG. **2** is a squeegee arrangement **9** which moves to-and-fro with reference to the workpiece supporting run of the carrier band **11**. The structural details and drive of this arrangement are shown in FIGS. **3** and **4**. A suction box **91** is located beneath the squeegee box of this arrangement, and beneath the supporting run of the carrier band **11**; it is connected in suitable manner (e.g. via a flexible hose **90**) with a suction pump **191**. A motor **291** moves the suction box **91** and the squeegee box of the arrangement **9** to-and-fro via rope drives **391** and **491**. In FIG. **4** the printing screen has been omitted for clarity, and in this Figure as well as in FIG. **3** the relationship of the components relative to one another is clearly visible. Also shown in FIG. **3** are the rails **591** which extend transversely to the direction of advancement of the carrier band **11** and on which the suction box **91** is supported with rollers **691**. Reference numeral **691***a* identifies drums onto which the ropes of the of the rope drives **391** and **491** can be taken up or from which they can be paid out.

FIG. **5** shows how suction applied to the box **91** through the hose **90** or in any other way acts through the supporting run of the carrier band **11** upon the outlet of the squeegee box of the arrangement **9** to draw printing medium (e.g. ink or any other medium which is to be applied to the workpiece **2**) into the workpiece so that it will not only be applied to the upper surface of the workpiece but will also be drawn into the work-

piece structure. The squeegee itself may be permeable to the suction.

To protect the workpiece supporting run of the carrier band **11** against damage by the constant contact with the suction box **91**, and in order to furnish additional support to the supporting run of the carrier band **11**, e.g. to reinforce it, a supporting belt **18** (which must of course be also gas permeable) may be located between the workpiece supporting run of the band **11** and the suction box **91**. The belt **18** may have one end connected to a transverse beam or support **100** of the frame **10** and its other end placed around a further beam or supporting member **200** of the frame **10** and connected to a takeup roller **218** of a tensioning arrangement **118**. The takeup roller is tensioned stepwise by means of a pawl **318** and ratchet wheel **418** so that the belt **18** can always be maintained in taut condition. The device **118** can be operated by inserting, e.g. a polygonal member into a matingly configurated hole **518** to turn the wheel **418** and the roller **218** stepwise as permitted by the pawl **318**. FIG. **2** shows that the belt **18** is located beneath the workpiece supporting run of the carrier band **11**. Means may be provided for displacing the belt **18** transversely of the path of movement of the band **11**.

As has been mentioned before, it is desirable to clean the carrier band **11** as it returns in the return run from the roller **211** to the roller **111**. For this purpose there may be provided adjacent the outlet end of the machine (as shown in FIG. **7**) a washing device **19** having a washing liquid reservoir **519** with an inlet **119** for fresh water or other cleaning liquid. A pump **219** pumps the cleaning liquid into a tube **319** which extends transversely of the carrier band **11** above the return run of the same (the connection to the tube **319** is to one axial end of the same which extends laterally beyond an edge portion of the carrier band **11**) so that water or other cleaning liquid is sprayed onto the upwardly directed surface of the return run of the band **11** to run through the same into a collecting box **419** arranged below the lower surface of the return run, from where the liquid can be recirculated via the conduit **619** into the reservoir **519**.

To remove moisture from the band **11** before it reaches the roller **211** there is provided downstream of the washing arrangement **19** a drying arrangement **20** having a fan **120** at the upper side of the return run and a collecting box **320** at the lower side of the return run. The fan, which may be electrically driven and may be provided with a heater to heat air which it blows onto the return run of the band **11**, drives residual moisture into the box **320** from where it is recirculated to the reservoir **519**. The suction inlet of the pump **219** is identified with reference numeral **719**.

It will be appreciated that various modifications may be made in the disclosed embodiments without departing from the scope and spirit of the invention as set forth in the appended claims.

While the invention has been illustrated and described as embodied in a screen printing machine, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. A screen printing machine, comprising a printing station including a printing screen; means for supporting and transporting a sheet-material workpiece to be printed, including an endless gas-permeable carrier band having a workpiece supporting run extending beneath said printing screen; suction means below said supporting run for drawing printing ink into the workpiece on said supporting run, including a suction device and means for moving said suction device to and fro below said printing run; and means between said supporting run and said suction device for reinforcing said carrier band and protecting the same against damage resulting from relative movement of said carrier band and suction device, the last-mentioned means comprising a gas-permeable belt and adjustable tensioning means for maintaining said belt in taut condition.

2. A machine as defined in claim **1**, said carrier band being a screen belt.

3. A machine as defined in claim **1**; and further comprising means for continuously advancing said carrier band in an endless path.

4. A machine as defined in claim **1**; and further comprising means for intermittently advancing said carrier band stepwise in an endless path.

5. A machine as defined in claim **1**; further comprising a drive for advancing said carrier band in an endless path; means for measuring the accuracy of print registry; and means electrically connecting said measuring means with said drive so that the latter is controlled in dependence upon the measurements of the former.

6. A machine as defined in claim **5**, said measuring means including a measuring device which is movable to-and-fro with reference to said supporting run in a measuring path, drive means for advancing said measuring device in said path from one to another end position, a pair of adjustable limit switches each adjacent one of said end positions for stopping said drive means when said measuring device reaches the respective end position, and means for adjustably displacing each of said limit switches lengthwise of said path towards the respectively other limit switch to vary the length of said path.

7. A machine as defined in claim **6**, said measuring means further including a control switch located ahead of one of said limit switches along said measuring path and engageable by said device, said drive for said carrier band including a creep-drive motor in circuit with said control switch and energized in response to engagement of the control switch by said device.

8. A machine as defined in claim **1**, said supporting and transporting means comprising a roller about which said carrier band is trained, and means mounting said roller in the region of one end thereof for pivoting movement about a pivot axis extending normal to said endless path.

9. A machine as defined in claim **8**, said mounting means including a pivot bearing; and further comprising a control motor coupled with said roller in the region of the other end thereof, and a sensor in circuit with said control motor and operative to sense the position of an edge of said carrier band on said roller and to signal deviations of said edge from a predetermined position to said control motor to operate the control motor.

10. A machine as defined in claim 1; further comprising means for displacing said gas-permeable belt transversely of said endless path.

11. A machine as defined in claim 10; said tensioning means being operative for tensioning said belt in the longitudinal direction thereof.

12. A machine as defined in claim 11, said tensioning means comprising a takeup roller for said belt, and a ratchet-and-pawl drive connected with said takeup roller to turn the take-up as required for tensioning said belt.

13. A machine as defined in claim 1; and further comprising washing means for passing a washing liquid through said carrier band to remove contaminants adhering to the carrier band.

14. A machine as defined in claim 13; and further comprising drying means downstream of said washing means for passing a stream of drying gas through said carrier band to remove moisture from the carrier band.

15. A machine as defined in claim 1, said printing station further comprising a suction-permeable squeegee.

16. A machine as defined in claim 1; further comprising a drive for advancing said carrier band in an endless path; means including a measuring device for measuring the accuracy of print registry; means electrically connecting said measuring device with said drive so that the latter is controlled in dependence upon the measurements of said device and for effecting movement of said device relative to said supporting run, including a limit switch and a control switch upstream of said limit switch as considered in the direction of movement of said device and both electrically connected to said drive for said carrier band, and a chain drive for restoring said device from one to the other of its end positions.

* * * * *